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Insights into Using IT-Based Peer Feedback to Practice the Students Providing Feedback Skill

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Abstract

The skills students need nowadays have changed over the last decades. The required skills are shifting more and more towards higher order thinking skills, such as critical thinking, collaboration and communication. One of the main ways of practicing these skills is through formative feedback, which consists of self-assessment and peer-assessment in our setting.

However, today's lecturers are facing the challenge that the number of students per lecture is continuously increasing, while the available budget is stagnating. Hence, large scale lectures often lack feedback, caused by the scarcity of resources. To overcome this issue, we propose a teaching-learning scenario using IT to provide formative feedback at scale. In this paper, we are focusing on the students' providing-feedback skill, which is important for collaborative tasks. In our experiment with around 101 master students, we were able to show that the students' ability to provide feedback significantly improved by participating in IT-based peer feedback iterations.

1. Introduction

Today's world is changing faster than ever before. Students graduating from university find a world that is highly volatile. Decisions need to be made with high uncertainty. The problems to be solved are often complex and interdependent. Large amounts of data lead to ambiguity during decision-making [2]. As a consequence, a question arises: "[how can you prepare] students for jobs that don't yet exist, using technologies that haven't been invented, in order to solve problems we don't even know are problems yet?" [32]. To prepare students for these challenges, a shift in the compositions of skills and knowledge is needed. In the past, for a longer period, students could mostly rely on the knowledge they once learned. Today, however, students need to constantly acquire new knowledge and the required skills are shifting more and more towards higher order thinking skills such as critical thinking, collaboration and communication [11].

To train these skills, two factors are most important a) a realistic teaching-learning scenario in which the students train such skills and b) the provision of formative feedback, which is, according to Hattie [15], one of the most important factors for students' performance.

We need to note that we use the term feedback twofold. First, it relates to the students' ability to provide feedback (feedback skill). Second, to practice this feedback skill, the students receive formative feedback. According to our definition, this formative feedback consists of a) self-assessment (SA), which is the student's own perceived skill level, and b) peer assessment (PA), which is the estimated skill level from the angle of the students' peers.

However, given the constant rise of student numbers, one of the major challenges is how to a) provide a teaching-learning scenario that is as realistic as possible and b) provide formative feedback in large-scale lectures effectively [13]. This challenge affects both campus universities as well as MOOC providers for distance learning. One solution might be to increase the teaching resources by scaling the number of teaching assistants and applying a tutor feedback model such as the one proposed by Marjanovic [22].

However, for most universities, this is not possible due to their financial resource constraints and frequently decreasing budgets. The numbers provided by the Organization for Economic Co-operation and Development (OECD) mirrors this development. According to them, the number of students at universities rose from 2005 to 2014 by 15 percentage points in the US and 29 in Germany, while public spending for education decreased in the same period by 7 percentage points in the US and 1 in Germany [27]. Furthermore, especially in large-scale lectures,

students perceive a high personal risk to fail when answering questions asked by the lecturer or fellow students, since a wrong answer might cause public embarrassment in front of the peer group [15]. Thus, students tend to only respond to questions they are fairly sure that they know the correct answer to [18].

Hence, as a solution, we propose IT-based peer feedback (ITPF), in which students a) find an almost realistic teaching-learning scenario in which they are not frightened by failure, since the collaboration is based on anonymity, and b) train their communication skills by providing feedback to their peers. Furthermore, through using ITPF the providing-feedback skill can be practiced in a normal lecture, without the need to offer additional seminars in which students exclusively learn this skill.

ITPF can be implemented using a learning management system (LMS) such as the web-based IT-tool Moodle [24] in a lean way that keeps the additional workload for a lecturer low, since the LMS facilitates the whole process of anonymizing and distributing the submissions and feedbacks. To assess the value of ITPF in large-scale lectures in general and in particular to educate students in higher order thinking skills, we seek to answer the following research question.

RQ: To what extent does participating in an ITPF help to train the students' ability to provide feedback?

To answer our research question, we offered students of a large-scale lecture the possibility to participate in seven ITPF iterations during the semester. The class was on business model innovation at the master's level. Between 73 and 101 students participated in each of the ITPFs. To grasp their development, the students had to self-assess their current ability to provide feedback to a peer prior to the first learning unit (baseline). After the lecture of each learning unit, the students completed a free-text or modeling submission and self-assessed their ability to provide feedback (SA). Afterwards, the system sent the submission anonymously to three peers for reviewing. Hence, each student had to write three reviews for their peers and received three peer reviews on his or her own submission. To ensure that the students received well-written feedback, the students in turn judged the quality of the feedback provided by their peers (PA). In the last step, the students rated their own ability to provide feedback to a peer (equal questions as the baseline).

SA and PA allows us to assess the development of the participants' ability to provide feedback using two different metrics: a) their perception of their ability to provide feedback and b) the judgements of the quality of the feedback the students received from their peers. Best to our knowledge the currently available research mainly concentrates on using ITPF to practice students' cognitive knowledge, such as declarative or conceptual knowledge. However, not much research has been reported on how to practice the students' providing-feedback skill. Hence, this study builds on a previously developed ITPF tool that has been used in large-scale lectures in university settings before [30].

The paper is structured as follows: In section two, we present the theoretical background, followed by the methodology chapter (three), which contains the experimental design, measurements and the ITPF process. In chapter four, we present the results of the experiment and which are the foundation for the discussion in chapter five. In the chapters six and seven, we conclude our work and discuss the experiment's limitations as well as provide an outlook for future research.

2. Theoretical Background

2.1 Importance of Feedback in the Learning Process

Multiple definitions of the term feedback have evolved during the last decades. However, since the early 2010s, there has been a shift on how feedback is defined in the literature. The understanding of feedback moved from information is 'given' to students towards feedback being seen as a process in which students have an active role to play [7].

In our paper, we use the following definition from Hattie [15], "[f]eedback is conceptualized as information provided by an agent (e.g., lecturer, peer, book, parent, self, experience) regarding aspects of one's performance or understanding". A lecturer can provide corrective information, a peer can provide an alternative strategy, and a book can provide information. Feedback, thus, is a 'consequence' of performance [15]. Hence, the outcome of feedback is an information specifically relating to the task or process of learning that fills a gap between what is understood and what is aimed to be understood [33].

The shift towards feedback as a process subsequently has effects on the roles of the lecturer and the student. Providing feedback should be driven by the student rather than by the educator. Feedback involves a multitude of players and necessarily involves the student making use of information to achieve change [7].

Feedback itself consists of two important components: On the one hand, the verification and, on the other hand, the elaboration part [20]. Verification describes the judgement of whether the response is

either “right” or “wrong”. The right/wrong decision is the first element of information encoded from feedback. In addition to the verification part of the response, the elaboration part provides information on why the response is either correct or incorrect [20].

According to Hattie [15], feedback in higher education must answer three major questions. The first question defines what the goals are about. The second question asks which progress is being made towards the goal. The third question asks what steps need to be taken to achieve a better student performance.

The first question addresses the learning goals related to the task or performance. The judgement concerning the learning goal may occur on many dimensions, such as directly “passing a test” or “completing a submission” [15].

The second question involves a lecturer/peer providing information in relation to a task or performance goal. Usually, this is related to prior performance and/or to success or failure on a particular task. According to the research of Hattie [15], feedback is effective when it consists of information regarding the progress and/or how to proceed with a certain task.

The last question helps the students to guide or provide advice that can lead to greater possibilities for learning. This could comprise more self-regulation over the learning process, greater fluency and automaticity, deeper understanding, more strategies and processes to work on the tasks, and more information about what is and what is not understood [15].

The previous paragraph is related to the information within feedback; however, feedback can be directed at four major levels and the level at which it is directed influences its effectiveness. The first level is feedback about a task or a product, so whether the work is correct or incorrect. Second, feedback can be aimed at the process used to complete the task or to create a product [15]. Third, feedback can address the self-regulation level. This may affect the skills in self-evaluation or the confidence to engage further on a task. This feedback can particularly influence the self-efficacy and self-beliefs of the students thinking about themselves as learners. Students can be encouraged or informed about how to improve their next steps to continue their task. The fourth and final level is with respect to the person itself. Hence, this feedback is directed to the self, such as “You are a great student” or “That’s an intelligent response, well done.” [15]. Therefore, it can be concluded that feedback on the “self” level is the least effective form of feedback, while feedback at the process and self-regulation level is the most powerful form in terms of deep processing and the mastery of tasks. The first level (feedback concerning the task) is powerful when the task information is subsequently useful for improving strategy processing or enhancing self-regulation [15]. Feedback, as we understand it, is based on a preceding assessment, either SA or PA, that judges a student’s performance [38]. The feedback involves the presentation and direct comparison of the results of these two assessments. Thus, it points out the students’ gap between their self-assessed and peer-assessed skill level regarding their ability to provide feedback. According to Butler [3], these three aspects initiate self-regulated learning processes, which is the foundation for developing higher order thinking skills.

2.2 Collaborative Learning

From an educational point of view, to develop the students providing feedback skill, we use collaborative learning as a teaching-learning scenario and in particular peer-feedback. Both build on the fundamental educational idea of constructivism.

Constructivism is the theory about how people learn. It focuses on the importance of individual knowledge, beliefs, and skills through the experience of learning [34]. According to Poplin [29], constructivists posit that learning is a process whereby new meanings are created (constructed) by the learner within the context of their current knowledge. Hence, learning is an active process of constructing rather than acquiring knowledge and instruction is a process of supporting that construction rather than communicating knowledge [5]. If the student acquires the strategies that meet the objective, then learning has occurred and last measurement occurs only through estimation with observation or dialogue [14].

Constructivism is the basic concept for collaborative learning. According to Dillenbourg [8], collaborative learning can be defined as a situation in which two or more people learn or attempt to learn something together. For our setting, this means that students work in pairs with the common goal of training their providing-feedback skill, while the setting is computer-mediated, asynchronously and anonymously. Collaborative learning not only enhances the students providing-feedback skills but even further, skills are developed, such as critical thinking or cognitive knowledge, like how to use the learned methods/information. However, our paper focuses on developing the feedback skill.

Collaborative learning can be divided into three interaction types: student-content interaction, student-lecturer interaction, and student-student interaction [25]. We consider these interaction types because interaction provokes learning activities that demand an

exchange between content, lecturers, and students in the ITPF process.

The first type is student-content, which can be identified as the "internal didactical conversation" when students "talk to themselves" about the information and ideas they encounter in papers, textbooks, lectures slides, etc. [16]. Hence, initiating the process of intellectually interacting with the content is the basis for changing the students understanding, perspective or the cognitive structures of the mind [25]. In the ITPF process, the student-content interaction is an important factor and takes place when the student is in both the creator and reviewer role while a) creating the submission and b) evaluating the quality of the submission and writing the review to provide peer feedback.

The second type of interaction is the student-lecturer interaction. Which follows three main goals. A) the lecturer seeks to enhance and maintain the students interest in the taught topic and to motivate the student to learn, including self-direction [25]. B) the lecturer tries to initiate self-regulated learning processes to enable the student to construct their own knowledge [5]. C) the lecturer organizes evaluations to ascertain if the students are making process and shows the gap between the intendent learning outcome and the students' current state of knowledge. In the ITPF process, the lecturer provides the theoretical concepts and knowledge in the lecture, which are necessary for completing the submission. Furthermore, instructions are provided on how good feedback is written, including examples.

The third type of interaction is the student-student interaction, in which students interact in pairs or in groups to construct their own knowledge. This collaborative interaction facilitates to develop leadership skills in the business context, critical thinking skills through reflecting one's own ideas with the peer group as well as providing feedback skills [6].

In the ITPF process, the student-student interaction is the foundation on which students construct their own knowledge. Through critically reviewing the students' submission, the reviewer needs, on the one hand, to reflect their own knowledge and, on the other hand, needs to think about how to structure the review and to convey their thoughts on how to improve the work of their peer. Especially the reviewer needs to put himself into the position of the peer student to communicate the ideas as convincingly as possible, so that the student can benefit from them. The interaction types discussed give important insights into why interaction is necessary for student performance and consequently for skill development.

2.3 IT-based Peer-Feedback

Although we showed the importance of feedback in the learning process, the environment of a large-scale class usually does not support it. Until today, the current conditions at universities is that lectures consist of hundreds of students and are taught by one lecturer [13]. ITPF describes the situation in which peers support each other in the learning process by using technology. ITPF can be defined as the process undertaken by the students to assess each other's work. Students provide, formative and qualitative evaluations of the products/submission or outcomes of learning of others in the team or group [19].

Through ITPF, students have the opportunity to receive and, even more importantly, provide feedback to other peers. Like this, the obstacles of providing feedback in massive classes are overcome using technology [33]. Hence, the lecturer saves valuable time, since the reviewing of the tasks is done by the students instead of the lecturer and the process is mediated by technology [33]. However, the time for organizing and managing the assessment process must not be neglected.

However, in contrast to the advantage of using ITPF in large-scale lectures, there are still some challenges. According to Tahir [37] and Ballantyne [1], students have difficulties in criticizing their peers, who are often their friends. Students perceive moral hazards and are afraid that their friends are not comfortable with them. To overcome this peer pressure, research pointed out that peer feedback should be carried out anonymously through an ITPF process [17].

However, anonymity can lead to students purposely giving their peers unjustifiably low scores, so that their scorers could put themselves in an advantageous position [4]. Hence, in our research, the students do not obtain a grade for carrying out the peer-feedback but rather receive points for the completion of the whole process in general.

2.4 Cognitive Dissonance Theory

To train the students' skill of providing and receiving feedback, we build on the cognitive dissonance theory (CDT). From an educational perspective, cognitive dissonance can be defined as an uncomfortable internal state occurring when the presented unfamiliar or contradictory information conflicts with existing knowledge [12]. The theory of cognitive dissonance states that individuals have a motivational drive to resolve this dissonance by either changing their beliefs, attitudes and behaviors or rationalizing them [12].

Through providing the students SA (the perceived skill level) and the PA (the skill level from the angle of the peers), such a cognitive dissonance can occur. Empirical studies of cognitive dissonance confirm that the need to resolve this dissonance is extremely motivating for students and activates cognitive processes until the dissonance is resolved [10]. One of the key aspects of the CDT is the relationship between the level of cognitive dissonance and the motivation to resolve it. Students might be quickly bored with a level of dissonance that is too easily resolved but can be frustrated with a level of dissonance that is too high [12]. According to Piaget [28], the dissonance is seen as an essential trigger for the learning process, resulting in students engaging in problem-solving activities and constructing new knowledge structures. As an added benefit to the learning process, the motivational aspects of resolving cognitive dissonance create an environment where students are continually exposed to content-relevant information facilitating deeper processing.

3. Methodology

3.1 Experimental Design

The ITPF tool (module implemented in Moodle) was used in a quasi-experiment with a one-group pre-/posttest design [23] in a large-scale university class on business model innovation at the master's level. The study consisted of seven ITPFs that took place in a weekly manner over a period of one semester. Between 73 and 101 students participated in each ITPF. In case a student did not participate in a particular ITPF, which leads to a missing value, this was statistically considered (marked as NA in R). Missing values as consequence lead to different Ns per construct. The attendance in the study was optional and rewarded with points for the final grade.

To ensure that the students had enough knowledge in terms of how the LMS Moodle works and how to provide constructive feedback to their peers, an initial tutorial session and a one-week practice test was carried out before the first ITPF iteration took place. In the tutorial session the overall ITPF process and the function of Moodle was explained followed by a hands-on instruction of how to provide constructive feedback. The instructions were based on common didactical guidelines for providing feedback, such as focus on the topic not the person, be constructive, write in I form etc. [31]. During training period, the learners were also invited to ask the lecturer and assistant with any questions regarding the ITPF, either in the classroom or via mail. After the end of the practice test, the first ITPF iteration was started.

In each ITPF iteration, for the SA and PA, two types of scales were used to gather rigor research data: a) SA using a percentage scale and b) PA using a Likert scale. In order to compare the SA and the PA, the percentage scale was transformed into a Likert scale using the following formula [39]:

$$SA_{likert} = (Likert_{max} - Likert_{min}) * (SA_{percent} - Percent_{min}) / (Percent_{max} - Percent_{min}) + Likert_{min}$$

We transformed the percentage scale to the Likert scale because the common transformation is from a higher granular scale to a low granular scale.

3.2 Measurements

Table 1 shows the items for measuring the students' ability to provide feedback. The SAQ1 measures the ability based on the students' own perception (SA). The items PAQ1-Q4 measures the students' ability based on the perception of the peers (PA). The mean value of the four items builds the construct ability to provide feedback (PA).

3.3 ITPF Process

Figure 1 shows the ITPF process used in our experimental setting. A student usually has two roles: a) being the reviewee; hence, they are the student who receives the peer feedback based on the uploaded submission and b) being the reviewer, writing three reviews in total to provide feedback to the peers. The ITPF process shown in Figure 1 shows the student in the role of being a reviewee.

In the first step, student A uploads the submission version 1. The submission contains the solution of student A, being an entrepreneur in applying the methods for describing and modeling their business model.

In the second step, the submission is anonymously distributed to the three reviewers. The three reviewers carry out an SA pre to rate their ability of providing feedback. This pre-SA is carried out only one time before the first ITPF iteration. Afterwards, the reviewers write the review to emphasize the strengths and weaknesses of the submission and how the submission could be improved. This is succeeded by carrying out an SA post. The SA post is carried out in every ITPF iteration. SA pre and SA post are rated on a percentage scale from 0 to 100% with 0% meaning the student judges his ability to provide feedback to peers to be very poor and 100% meaning very good.

In the third step, student A receives the three reviews.

Table 1. Survey Questions Self-Assessment (SA) and Peer-Assessment (PA)

Item	Type	Question	Scale	Source
SAQ1	SA	How do you rate your personal ability to give feedback to your fellow students related to their professional achievement?	Percentage: 0-100%	O.D.
PAQ1	PA	The feedback I got from Reviewer X was helpful.	Likert: 1-7	[36]
PAQ2	PA	The feedback I got from Reviewer X was high quality.	Likert: 1-7	[21]
PAQ3	PA	Reviewer X was able to identify critical aspects in my submission.	Likert: 1-7	[21]
PAQ4	PA	The reviewer X was able to provide constructive suggestions on his stated critical aspects.	Likert: 1-7	[21]

O.D. = Own Development

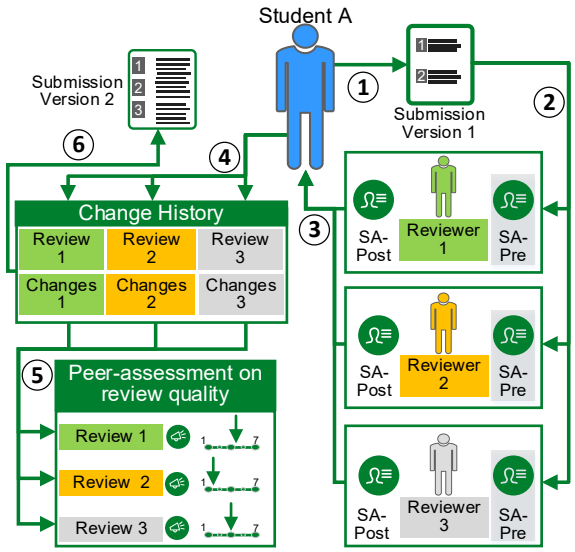

Figure 1. Steps of the ITPF Process

In the fourth step, student A creates a change history. This contains the reviews as well as how the comments from the reviewer were absorbed and the changes for the final submission.

In the fifth step, student A provides feedback on the review quality (PA), meaning how helpful it was. The question was based on a Likert scale from 1 (poorest quality) to 7 (highest quality).

In the final step, student A revises the submission based on the change history and uploads version 2.

4. Results

For the data analysis, we used R version 0.99.902 without any additional packages. As statistical methods, we used the R two-sided, paired t-test. The graph in Figure 2 shows the survey results for the SA (solid line) question SAQ1 (Table 1) and the PA (dashed line) average of questions PAQ1 to PAQ4 (Table 1). The first measurement t0 is the baseline measurement at the beginning of the class, before the first ITPF iteration took place. For the baseline measurement, there is no PA available, since the peers did not review a submission yet. In t0, the students carried out the SA pre and self-assessed their ability in providing feedback to their peers (SA).

Time points t1 to t7 show the seven ITPF iterations. Comparing t0 to t1, (SA, solid line) the students' perceived ability to provide feedback to peers increased by .65 points on the Likert scale, which is highly significant ($p < .001$). Moreover, when considering the time points t1 to t7 (SA, solid line), the students enhanced their perceived ability of providing feedback through using ITPF multiple times. The difference from t1 to t7 is .229 points for the SA ($p < .05$). For the SA (solid line), the difference from t0 to t1 is the sharpest increase (.65 points) in the students' ability of providing feedback. This increase is followed by a smaller growth between t1 and t2 of .174 points. From t2 to t6, the line settles at around 5.6 points. The line ends with an increase of .143 points in t6 to t7.

The second line (dashed) in Figure 2 represents the PA of the students' ability of providing feedback. The line starts with a sharp increase by .516 points in t1 to t3. Followed by a drop of .207 points from t3 to t4. In the minimal turning point, the line increases again to 5.618 points and decreases afterwards from t5 to t7 by 183 points. The increase as shown by the dashed line PA from t1 to t7 is significant ($p < 0.05$).

Table 2 shows an overview of the statistics. We calculated the mean and standard deviation for SA and PA with two intervals: a) t0 to t1 and b) t1 to t7. The mean for SA interval a) is 5.17 points (SD = .459) on the Likert scale and for SA interval b) 5.626 (SD = .076).

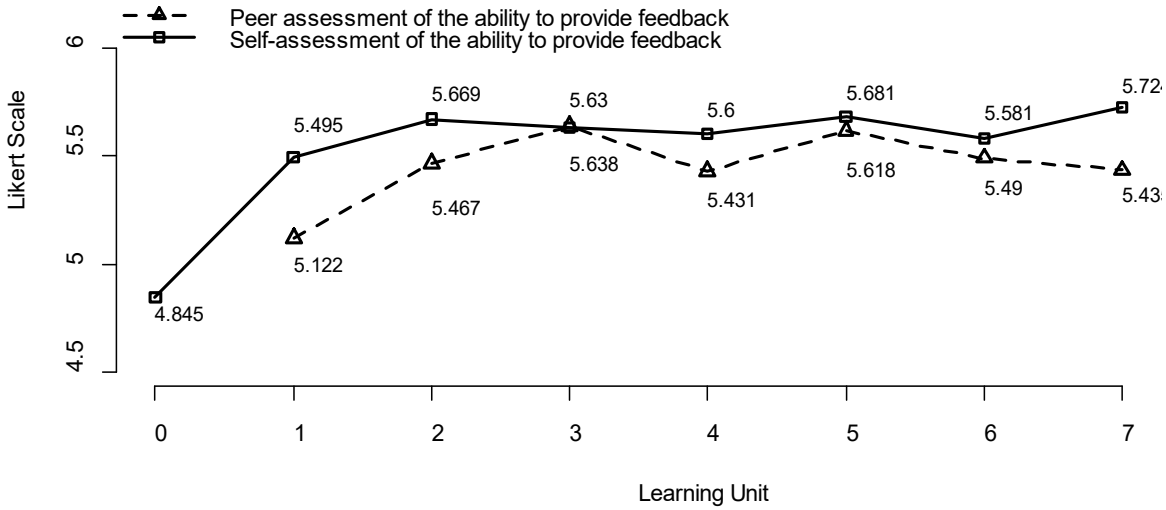

Figure 2. Results of the students' ability to provide feedback to peers (SA and PA)

The PA interval a) is not available, since the peers did not review a submission yet. For interval b) the mean is 5.457 points (SD = 0.17).

5. Discussion and Implications

ITPF is not new to higher education and was already investigated in the 1970s [35]. However, there is still a lack of empirical research using ITPF in quasi-experiment design settings [40], since, best to our knowledge, the current available research mainly concentrates on using ITPF to practice students' cognitive knowledge, such as declarative or conceptual knowledge. The aim of our study is to investigate whether ITPF can be used to practice the students providing-feedback skill in large-scale lectures with limited available resources.

The findings of our empirical research show that using ITPF has a significant positive effect on the students' ability to provide feedback. This effect has been proven in terms of SA and PA. Our results further show that students' ability to provide feedback already benefits from a onetime usage and benefits even further when ITPF is used multiple times in the learning process. This leads to the conclusion that students highly benefit from the usage of ITPF in the learning process, especially in terms of educating students in how to provide feedback. Interestingly, considering the ability to provide feedback in terms of SA and PA, there is a tendency for students to rate their personal ability to provide feedback higher than the ability assessed by their peers. For time point t1 (SA-PA) and t7 (SA-PA), this can be statistically proven with a two-sided, paired t-test, which shows that $p < .05$.

It has to be taken into account that the students did not receive feedback on how their PA of the submissions had been rated. Thus, when the students self-assessed their ability of providing feedback, they did not know how their peers ranked their ability of providing feedback in the previous ITPFs. According to Moshavi [26], over-estimators are believed to be associated with the most negative individual and organizational outcomes. This can lead to a misdiagnosis of strengths and weaknesses of the over-estimators and results in ignorance towards how others perceive them [26].

Hence, possible future research could include providing feedback on the previous PA results before each ITPF. It could be investigated if a convergence between the SA and PA takes place over time, to decrease the students' overestimation concerning their ability of providing feedback. Furthermore, in the current research setting, cognitive dissonance theory may be a hint why the students SA increased over time. Since each student, on the one hand, wrote three reviews and, on the other hand, received three reviews, the dissonance maybe occurred while comparing one's own to the received reviews. Consequently, the student tries to minimize this dissonance. However, since a student could also receive a bad written review, there needs to be further research to proof this statement. Especially interesting will be measuring the cognitive dissonance when showing the students the SA and PA scores at the same time. Considering the line SA of the ability of providing feedback, the drop

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Table 2. Statistical results of the students' ability to provide feedback to peers (SA and PA)

Self-assessment (SA)			
Time point (t)	Statistics (in points)	t(df) = t-value	Differences (in points)
0 to 1	Mean = 5.17, SD = .459	t(77)= 5.736***	.65
1 to 7	Mean = 5.626, SD = .076	t(87)= 2.978*	.879
Peer-assessment (PA)			
Time point (t)	Statistics in points	t(df) = t-value	Differences (in points)
0 to 1	-	-	-
1 to 7	Mean = 5.457, SD = 0.17	t(97)= 2.472*	.344

Significance with * p= <.05, *** p= <.001 SD=Standard Deviation

in t4 (Figure 2) may be caused by the change of the task from a descriptive to a modeling manner.

This tendency is also the case regarding t6. However, the correlations cannot be statistically proven. The tendency shows that the ability of providing feedback may be related to task difficulty and complexity. Further research needs to be carried out to statistically prove this possible correlation

The results of this paper are of practical relevance for researchers, lecturers, and practitioners alike, since they illustrate how ITPF can support students in practicing their ability to provide feedback. The theoretical contribution of our research is in providing a first step, of applying the cognitive dissonance theory as a theoretical lens for explaining why students' ability to provide feedback increases over time. Furthermore, we contribute to the collaborative learning theory by contributing empirical results. We used the collaborative learning theory in an innovative teaching-learning scenario in which students develop their own business model over time and simultaneously practice the skill of providing feedback to peers.

6. Limitations and Future Research

Any findings of an empirical study need to be considered in the light of its limitations. Since we gathered our data in a real class that provided the students with the possibility to take part in a quasi-experiment with a one-group pre-/posttest design, we did not have an experimental setting with a control group. This leads to the fact that we cannot precisely prove that the ability of providing feedback to peers exclusively results from the participation of the students in the ITPFs.

Sometimes, based on practical and ethical reasons, it is not possible to use randomization when selecting participants for a treatment or control group [23]. This is the case at our university. It is not allowed to force students to participate into a control or a treatment group, which is based on legal regulations of the university. The randomized classification could lead to disadvantages for the students in their learning process because the students of the control group do not receive the benefits like the students in the treatment group do.

However, according to Millsap [23], a quasi-experiment has up to seven threats for internal validity (maturation, history, seasonality, testing, instrumentation, attrition and statistical regression). Nevertheless, these threats heavily depend on the actual design setting, such as the type of treatment, the participants, the time between pre- and post-test, etc. According to Dillenbourg [9], none of these threats is likely plausible in educational interventions that teach materials that are highly unlikely to be learned somewhere else between the pre- and post-test.

If the threats to internal validity play a role, this mainly depends on the context in which the quasi-experimental design is used and is built on two conditions: a) the pre- and post-test measure focus solely on the material being taught and b) the time interval between the pre- and post-test is short. Both conditions are met in our study and, hence, this leads us to the conclusion that our research findings have valid insights.

Moreover, for further research, the research design could be revised in a way that the number of ITPFs is halved. In the first half, the first group would be the treatment group and the second group the control group and in the second half vice versa. However, this would have an impact on the learning effect because the students need to get comfortable with the setting of PA and its processes. Additionally, in future research, the impact of the submission on the PA could be investigated by using a questionnaire that retrieves the difficulty and complexity of the submission. Hence, the correlation between the submission's complexity, knowledge growth, and ability of providing feedback could be investigated.

7. Conclusion

This paper has described the usage of ITPF in a large-scale lecture to train the students' ability to provide feedback. The results show that the usage of ITPF could enable the lecturer to support students in their learning process in a resource-saving way and to provide an environment in which students can anonymously train their ability to provide feedback. We emphasize that providing feedback is an important skill for students graduating university. However, this skill is usually neglected, caused by the problems of large-scale lectures and the scarcity of resources, which lead to a lack of feedback.

The results of the quasi-experiment with a one-group pre-/posttest design shows that, when using ITPF, the students' ability of providing feedback increases significantly. The discussion and implications describe the importance of ITPF concerning a learner-centered approach. Despite the limitations of the study, the results show the effectiveness of ITPF regarding the learning process of students.

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